US Dietary Patterns Associated with Fat Intake: The 1987 National Health Interview Survey

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ABSTRACT

Objectives. This research used food frequency data to investigate dietary patterns associated with fat intake.

Methods. Data from the 1987 National Health Interview Survey of 20 143 adults were used to determine correlations between fat (adjusted for kilocalories) and both nutrient and food group intakes. Median food and nutrient intakes were determined within quartiles of percentage of kilocalories from fat.

Results. Intakes of vegetables, fruits, cereals, fish/chicken, low-fat milk, alcoholic beverages, vitamin C, percentage of kilocalories from carbohydrates, carotenoids, folate, dietary fiber, carbohydrates, and vitamin A decreased as percentage of kilocalories from fat increased. Intakes of salty snacks, peanuts, processed and red meats, whole milk and cheese, desserts, eggs, fried potatoes, table fats, cholesterol, vitamin E, sodium, protein, and energy increased with percentage of kilocalories from fat. Results by demographic subgroups showed few differences from those found in the total population.

Conclusions. Fat intake is consistently associated with specific dietary patterns. Such patterns need to be evaluated concurrently in studies of diet and chronic disease. (*Am J Public Health.* 1994;84:359-366)

Introduction

In the last 2 decades, there has been increasing interest in the role of dietary fat in chronic disease. The consensus among major scientific organizations is that fat intake should be reduced below current levels in the United States to reduce the risk of heart disease, cancer, and obesity[1-6]; the most common recommendation is that individuals reduce their fat intake to 30% of calories (kilocalories) or less.[3,4,6] Many of these organizations recommend concurrent dietary guidelines that include increased fruit and vegetable intake to five daily servings,[2,3,6] increased intake of whole grains and dietary fiber,[1,3-6] and reduced sodium intake.[1-6] When individuals change their fat intake, however, a variety of other dietary changes may occur to balance caloric intake. Food selections are based on food preference and availability, budget, social environment, and other factors. A low-fat diet can be implemented in a variety of ways: increasing intake of fruits, vegetables, complex carbohydrates, and/or low-fat dairy products and decreasing intake of meats, table fats, whole milk and cheese, and/or baked goods. These choices may produce quite different dietary patterns, many of which could constitute a diet low in fat. Two recent studies[7,8] examined dietary patterns and fat intake in small numbers of women (172 and 17, respectively) volunteering for clinical trials designed to reduce fat intake. The purpose of the present study is to quantify the relationships between dietary patterns and diets either low or high in fat among 20 143 adults interviewed in the nationally representative 1987 National Health Interview Survey (NHIS).

Methods

The 1987 NHIS, conducted by the National Center for Health Statistics, was administered throughout calendar year 1987 to 44 123 individuals and had a response rate of 82%. The survey was designed to represent US households in the 48 contiguous states.[9] One adult per household was randomly selected to be administered the Cancer Risk Factor Supplement, developed and funded by the National Cancer Institute. Details regarding the methodology of the Cancer Risk Factor Supplement and the collection of dietary data can be found elsewhere.[10] Briefly, in a split-sample design, either the cancer control or the epidemiology questionnaire was administered. Door-to-door, in-home interviews of non-institutionalized individuals were conducted by experienced Bureau of the Census interviewers. For respondents not found at home after repeated visits, interviews were obtained by telephone whenever possible (approximately 16%). Hispanics were oversampled, and a Spanish translation of the interview was used when necessary.

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TABLE 1—Distribution of Demographic Groups in Quartiles of Percentage of Kilocalories from Fat: National Health Interview Survey, 1987

Demographic Group	Sample Size	Quartile %[a]			
		1	2	3	4
Sex					
Male	8385	25.7	25.1	25.0	24.2
Female	11 758	24.1	24.5	25.0	26.4
Age, y					
18–34	7462	22.7	25.8	26.8	24.6
35–49	5269	23.8	23.7	25.8	26.7
50–64	3604	27.2	24.5	22.5	25.8
65+	3808	29.3	24.5	22.0	24.2
Race/ethnicity					
White	16 065	23.6	24.9	25.2	26.4
Black	2748	25.0	22.5	26.5	25.9
Hispanic	1330	39.7	26.7	20.7	12.9
Education, y					
<12	4725	25.2	23.0	24.3	27.5
12	7632	21.4	24.0	26.5	28.2
>12	7731	28.3	26.6	23.9	21.2
Unknown	55	27.8	31.9	21.1	19.2
Income, dollars					
<14 000	5476	25.8	22.9	25.5	25.8
14 000–29 999	6150	23.2	23.9	25.5	27.4
30 000–49 999	4264	22.8	26.1	26.0	25.1
≥50 000	2112	30.4	27.7	21.4	20.5
Unknown	2141	25.4	24.3	24.9	25.4

[a]Quartile cutpoints for percentage of kilocalories from fat were 33.9%, 38.8%, and 43.3%.

The dietary interview, consisting of a 59-item food frequency questionnaire developed by Block et al.,[11] was administered to 22 080 adults and lasted an average of 17 minutes. Individuals were asked to report the number of times per day, week, month, or year they consumed each food item. Portion size was asked for each food item (small, medium, or large), and age- and sex-specific portion sizes were used to estimate nutrient intake.[12] The 59 food items included on the questionnaire were selected to represent the foods that were the major contributors of nutrients in adult diets based on analyses of nutrient sources[13,14] from 24-hour dietary recall data collected in the second National Health and Nutrition Examination Survey (NHANES II) during 1976 through 1980. The longer 98-item questionnaire on which this instrument was based was validated in several studies[15–18] and has shown good ranking of individuals and reasonable estimates of mean nutrient intake. Correlations between nutrients estimated by multiple days of diet records or the 59-item questionnaire were comparable to those found with the longer version.[11] Of the 22 080 adults who were administered the questionnaire, approximately 6% were excluded from analysis because of coding, interviewer, or respondent error, as were individuals reporting a racial or ethnic identification other than White, Black, or Hispanic. Data on 20 143 individuals were analyzed.

Nutrient estimates were calculated with the database and software developed by Block et al. based on the NHANES II food database.[12] In comparison with the 98-item questionnaire, the 59-item instrument tends to underestimate absolute intake of macronutrients and some micronutrients but may overestimate vitamins A and C. However, percentage of kilocalories from macronutrients is considered accurate.[19] Because of this concern about estimates of absolute intake, relative intake and dietary patterns are emphasized. Adjustment coefficients[19] were not used. The 59 food items were categorized into groups (not always mutually exclusive) based on nutritional, functional, and botanical similarities, and total servings per week were calculated (a description of the food groups is available on request).

Individuals were categorized by their percentage of kilocalories from fat, a measure widely recognized as of interest to public health. First, distributions were examined separately by sex, by race/ethnicity, by age (19 through 34, 35 through 49, 50 through 64, 65+ years), and by eight sex-age groups. Distributions for all subgroups were nearly identical, except for Hispanics, who had somewhat lower percentages of intake of kilocalories from fat. Thus, subjects were assigned to quartiles of percentage of kilocalories from fat based on the total population. Medians for nutrient and food group intake were examined by quartile for all age-sex groups and by race/ethnicity, education (<12, 12, >12 years), and household income (<\$14 000, \$14 000 through \$29 999, \$30 000 through \$49 999, ≥\$50 000). Three methods were used in examining correlations between fat intake and nutrient/food group intake controlling for total caloric intake. The first method involves Pearson product moment correlations between absolute nutrient intake and percentage of kilocalories from fat, a commonly used procedure yielding results that can be compared with those of other studies. The second method computes Pearson correlations between age- and sex-specific percentiles of nutrient intake and percentage of kilocalories from fat. The use of percentiles adjusts nutrient intake for age and sex differences. In addition, this procedure has the advantage of not being unduly influenced by extreme values of nutrient intake. The third method uses partial correlations between the nutrient/food group and total fat intake adjusting for kilocalories, age, and sex. All correlations and median intake values were calculated by using sample weights in SAS[20] and SUDAAN.[21]

Results

The mean percentage intake of kilocalories from fat for the entire NHIS population was 38.4% (range = 6.0% to 71.6%). Weighted quartile cutpoints for percentage of kilocalories from fat were 33.9%, 38.8%, and 43.3%. Table 1 shows the number and percentage of individuals in each quartile by demographic subgroup. Hispanics were more likely to be in the lowest quartile than were Whites or Blacks. The percentage of individuals in the lowest quartile increased consistently with age, while the percentage in the third quartile decreased from the youngest age groups to those 50 or older. Analyses by education and income showed that both the wealthiest and the most educated were more likely to consume a low percentage of kilocalories from fat.

Table 2 shows that the correlation coefficients between nutrient intake and fat adjusted for kilocalories obtained with the three methods described above were quite similar. Exceptions were oleic acid, saturated fat, and carbohydrate, for which the partial correlations with fat adjusted for calories were noticeably larger than either correlation with percentage of kilocalories from fat. On the basis of the overall similarity of the three approaches, additional analyses used simple correlations.

The correlations for macronutrients (Table 2) show that total fat and fat constituents (oleic acid, saturated fat, linoleic acid, and cholesterol) were most highly positively correlated with percentage of kilocalories from fat (r's ranging from $-.29$ to $.42$). Protein ($r = .13$) and carbohydrate ($r = -.19$) had low correlations, with protein increasing and carbohydrate decreasing with increased percentage of kilocalories from fat. The percentages of kilocalories from fat and from carbohydrate were strongly negatively correlated ($r = -.73$), compared with only a slight positive correlation for percentage of kilocalories from protein ($r = .08$). Energy intake had a low positive correlation ($r = .07$) with percentage of kilocalories from fat.

Of the micronutrients, vitamin C had the largest negative correlation with percentage of kilocalories from fat ($r = -.32$). Folate, dietary fiber, and carotene also had negative correlations (r's of approximately -0.2), and vitamin E and sodium had positive correlations of similar magnitude. Correlations were less than $\pm.10$ for all other nutrients. Simple correlations with percentage of kilocalories from fat for all nutrients in Table 2 were also determined by sex, four age groups, three race groups, three education groups, and four income groups to investigate differences from the total population correlations. Of the 400 possible correlations, only 7 (2%) varied by $\pm.10$ from the population correlation, and no consistent patterns emerged.

Table 3 shows the absolute median intake of nutrients by percentage of kilocalories from fat quartile and the ratio of medians in quartile 4 to medians in quartile 1. Nutrients are listed in descending order by ratio. The similar order of the nutrients in Table 2 (by correlation coefficient) and Table 3 (by ratio) suggests relative consistency in their associations with percentage of kilocalories from fat. Energy intake was 14% greater for individuals in the highest compared with the lowest quartile. For fat and its constituents, the differences were more dramatic, with intakes of oleic acid, saturated fat, linoleic acid, and total fat almost twice as great, and cholesterol two thirds as great in the fourth as in the first quartile. Similar to energy, intake of protein was 17% greater in the fourth than the first quartile. Intake of total carbohydrate in the fourth quartile was about one quarter of that in the first, while percentage intake of kilocalories from carbohydrate was three quarters of that in the first.

Results for micronutrients and fiber showed a trend for intakes of vitamin C, dietary fiber, folate, and carotene, all of which are found primarily in fruits and vegetables, to be lowest in the highest quartile. The gradient was most striking for vitamin C, with intake in the fourth quartile about 60% of that in the first. Intakes of dietary fiber, folate, and carotene among those in the highest quartile were all about three fourths of those in the lowest. In contrast, intakes of sodium and vitamin E were higher in the fourth quartile than in the first (1.24 and 1.33 times as great, respectively). Other nutrients varied little by quartile. While absolute intake of nutrients varied by age and sex (data not shown), the overall pattern of nutrient intake by percentage of kilocalories from fat differed little when ratios were compared (the largest ratio range [1.17 to 2.03] involved saturated fat). Examination of comparable ratios by education, income, and race showed that of the 250 ratios calculated, 2 differed by more than $\pm.20$ from the population ratio.

Table 4 provides correlations between intake of food groups (number of servings per week) and percentage of kilocalories from fat. Results for all three methods were essentially the same, with the exception of alcoholic bever-

TABLE 2—Correlations between Fat and Nutrient Intake: National Health Interview Survey, 1987

Nutrient	Simple Correlation[a]	Percentile Correlation[b]	Partial Correlation[c]
Fat	.42	.55	1.00
Oleic acid	.42	.55	.95
Saturated fat	.40	.51	.87
Linoleic acid	.37	.47	.55
Cholesterol	.29	.36	.36
Vitamin E	.20	.26	.27
Sodium	.17	.21	.30
Protein	.13	.16	.24
Protein, % kcal	.08	.08	.14
Energy	.07	.12	.14
Iron	.02	.03	.03
Phosphorus	−.001	−.01	−.10
Retinol	−.004	.01	−.01
Calcium	−.02	−.02	−.04
Niacin	−.02	−.02	−.17
Thiamin	−.04	−.05	−.06
Riboflavin	−.04	−.05	−.11
Potassium	−.06	−.08	−.14
Vitamin A	−.08	−.08	−.07
Carotene	−.15	−.14	−.13
Carbohydrate	−.19	−.23	−.62
Fiber	−.22	−.22	−.24
Folate	−.24	−.26	−.35
Vitamin C	−.32	−.30	−.32
Carbohydrate, % kcal	−.73	−.70	−.60

[a]Pearson correlation of percentage of kilocalories from fat with absolute intake.
[b]Pearson correlation of percentage of kilocalories from fat with age- and sex-specific percentile of intake.
[c]Correlation of grams of fat with absolute intake (controlling for age, sex, and kilocalories).

TABLE 3—Median Nutrient Intake, by Percentage of Kilocalories from Fat Quartile: National Health Interview Survey, 1987

Nutrient	Quartile %[a] 1	2	3	4	Ratio[b]
Oleic acid, g	15.9	21.9	26.0	29.7	1.87
Saturated fat, g	16.5	23.0	26.9	30.6	1.85
Linoleic acid, g	8.0	11.0	13.1	14.9	1.86
Fat, g	44.5	61.1	71.4	82.1	1.84
Cholesterol, mg	200	257	302	331	1.66
Fat, % kcal	30.1	36.5	40.9	46.3	1.54
Vitamin E, alpha tocopherol equivalents	4.9	5.7	6.2	6.5	1.33
Sodium, mg	1948	2204	2360	2414	1.24
Protein, g	54.2	61.0	63.7	63.4	1.17
Energy, kcal	1381	1509	1571	1575	1.14
Protein, % kcal	15.6	16.1	16.2	16.2	1.04
Phosphorus, mg	1008	1061	1071	1021	1.01
Iron, mg	9.4	9.9	10.1	9.5	1.01
Thiamin, mg	1.0	1.0	1.0	1.0	1.00
Retinol, mg	595	632	627	583	0.98
Niacin, mg	14.2	14.6	14.9	13.9	0.98
Calcium, mg	680	705	709	655	0.96
Riboflavin, mg	1.5	1.6	1.6	1.4	0.93
Potassium, mg	2231	2234	2233	2067	0.93
Vitamin A, retinol equivalents	1098	1074	1048	950	0.87
Carbohydrate, g	172	168	162	141	0.82
Dietary fiber, g	10.4	9.6	9.0	7.9	0.76
Folate, µg	262	239	224	194	0.74
Carotene, µg	2494	2232	2108	1848	0.74
Carbohydrate, % kcal	51.0	45.4	41.7	36.3	0.71
Vitamin C, mg	134	114	100	80	0.59

[a]Quartile cutpoints were 33.9%, 38.8%, and 43.3%.
[b]Ratio of quartile 4 to quartile 1.

ages, and simple correlations were used in further analyses. Servings of table fats and "all meats" represented the food group most highly positively correlated with percentage of kilocalories from fat (approximately .35). The "all meat" subgroups (processed meats and red meat) had positive correlations, while fish and chicken were essentially uncorrelated. Eggs, cheese, and whole milk were also positively correlated ($r = .21$) with percentage of kilocalories from fat, while low-fat milk was negatively correlated ($r = -.19$). The "all breads" food group and starches, representing good sources of complex carbohydrates, showed essentially no correlation to percentage of kilocalories from fat. Fried potatoes alone did, however, show a low positive correlation ($r = .14$). High-fiber bread/cereal and ready-to-eat cereals showed low negative correlations ($r < .20$). Without exception, fruits and vegetables (not including potatoes), as a single food group ($r = -.27$) and when divided into subgroups, were negatively correlated with percentage of kilocalories from fat; the fruit and juice group and the citrus fruit group showed the strongest negative correlations. Alcoholic beverages were inversely correlated with percentage of kilocalories from fat ($r = -.29$). However, the partial correlation between alcoholic beverages and grams of fat (controlling for age, sex, and kilocalories) was $-.50$. As in the case of nutrients, simple correlations were computed for percentage of kilocalories from fat with all food groups by age, sex, race, education, and income subgroups. Of the 432 possible correlations for all food groups by each demographic factor, only 3 were more than $\pm.10$ from the total population simple correlation.

Table 5 shows the median number of servings per week of food groups within each quartile, as well as the ratio of servings per week in the fourth to first quartile in descending order. In comparison with nutrients, the ratios for foods were generally greater. Food groups with the strongest correlation coefficients in Table 4 also tended to show the greatest differences in absolute intake across quartiles. Salty snacks and peanuts had the highest ratios. Absolute servings of table fats were almost twice as great among individuals in the highest than in the lowest quartile. Those in the highest quartile reported eating meat ("all meat" group) more than 10 times per week, as compared with about 6 times per week for those in the first quartile. Results for red and processed meat were consistent with this finding, showing intakes 1.7 and 3.2 times as great in the fourth than in the first quartile, respectively. Servings of fish and chicken in the fourth quartile, however, were 80% of those in the first. Intake of whole milk and cheese was 2.5 times higher in the upper quartile, while low-fat milk intake declined to a median of zero from the first to the fourth quartile. Intake of starches, nonfried potatoes, and all breads showed no major differences across quartiles, but intake of fried potatoes was two times as great in the fourth than in the first quartile. Intake of both ready-to-eat cereal and high-fiber bread/cereal was about half as great in the fourth as in the first quartile. Intakes of fruits and vegetables combined, vegetables excluding potatoes, and fruits alone were all lower among those in the highest quartile. For citrus fruits (primarily oranges) and for fruits and juice, the differences in intake between those in the lowest and highest quartiles were twofold to threefold. Alcoholic beverage intake in the highest quartile was one eighth that in the lowest quartile.

Median intake of food groups and the ratio of quartile 4 to quartile 1 were also determined by race, education, and income categories (results available on request). For salty snacks, peanuts, and low-fat milk, meaningful ratios could not be calculated as a result of zero median intake in quartile 1 or quartile 4. For all meat, all bread, all vegetables, garden vegetables, fruits and vegetables, and citrus fruits, there were no ratio differences greater than $\pm.20$ from the total population ratio presented in Table 5. For the other 18 food groups, 42 of a possible 180 ratios varied from the total population ratio by greater than $\pm.20$, and 22 were greater than $\pm.50$. However, no particular demographic subgroup emerged that had a clear pattern of difference from the total population.

Heavy alcohol consumers tended to be categorized as having a low percentage of kilocalories from fat in their diets. The heaviest drinkers (primarily 18- to 34-year-old men) were easily categorized into what appeared to be the healthiest diet. However, when we either eliminated those consuming more than 20 alcoholic drinks per week from the analyses or removed all kilocalories from alcoholic beverages, establishing new quartile cutpoints for percentage of kilocalories from fat, our overall results regarding either correlations or absolute intake of nutrients or food groups did not change. Therefore, no exclusions were made on the basis of alcohol consumption, allowing for the reality of alcohol intake in the US diet.

Discussion

We have shown, in nationally representative data, that the percentage of kilocalories from fat in the diet is consistently correlated with specific nutrients and food groups across demographic variables of age, sex, race, education, and income, and we found a consistent pattern in the relative change in nutrient and food group intake across quartiles by demographic subgroups. Some of our findings are surprising, while others are not. Given that percentage of kilocalories from fat is different from absolute fat intake, it does not necessarily follow that all foods with substantial fat content will necessarily highly correlate with percentage of kilocalories from fat. The strength of the correlation depends on amount consumed and on fat and caloric content. As expected, high positive correlations were found between percentage of kilocalories from fat and both fat constituents and high-fat food groups. The negative correlations with vitamin C, folate, fiber, carbohydrate, and carotene and associated food groups, however, were less expected. Fruits, vegetables, low-fat milk, and ready-to-eat cereal appear to contribute to a diet low in percentage of kilocalories from fat because they are rich in carbohydrates and substitute carbohydrate kilocalories for fat kilocalories and also because they may be part of a dietary pattern that includes fish and chicken and limits red meats, processed meats, table fats, and eggs. It appears that as individuals decrease their percentage of kilocalories from fat, they substitute primarily carbohydrate- rather than protein-rich foods for energy replacement, partly because protein and fat occur together in many foods.

TABLE 4—Correlations Between Fat and Food Group Intake (Servings per Week): National Health Interview Survey, 1987

Food Group	Simple Correlation[a]	Percentile Correlation[b]	Partial Correlation[c]
Table fats	.37	.38	.37
Processed meats	.36	.41	.39
All meat	.31	.35	.37
Salty snacks	.24	.27	.25
Red meat	.22	.26	.23
Whole milk and cheese	.21	.27	.21
Eggs	.21	.23	.19
Desserts	.17	.20	.18
Fried potatoes	.14	.22	.13
Peanuts	.13	.14	.13
Nonfried potatoes	.05	.07	.05
Dairy products	.03	.04	.02
All bread	−.002	.04	−.03
Stew and soup	−.03	.002	−.02
Starches	−.03	−.01	−.06
Fish and chicken	−.05	−.06	−.05
Salads	−.10	−.09	−.08
All vegetables	−.11	−.09	−.10
Soft drinks	−.12	−.03	−.20
High-fiber bread/cereal	−.15	−.14	−.11
Garden vegetables	−.17	−.15	−.14
Low-fat milk	−.19	−.20	−.17
Ready-to-eat cereal	−.19	−.16	−.16
Fruits and vegetables	−.27	−.25	−.25
Citrus fruit	−.29	−.26	−.27
Fruit and juice	−.29	−.27	−.26
Alcoholic beverages	−.29	−.22	−.50

[a]Pearson correlation of percentage of kilocalories from fat with absolute intake.
[b]Pearson correlation of percentage of kilocalories from fat with age- and sex-specific percentile of intake.
[c]Correlation of grams of fat with absolute intake (controlling for age, sex, and kilocalories).

It is surprising that intakes of nonfried potatoes, starches, and breads changed little with quartiles of percentage of kilocalories from fat since these are foods that Americans are encouraged to consume for purposes of achieving a low-fat diet. In part, this is because of the fats frequently added to these foods (reflected in the NHANES II database used here) that increase their percentage of kilocalories from fat. Furthermore, the stability of these starchy food groups across quartiles suggests that they are staples at all levels of fat intake. Total dairy product intake varied little by fat quartile. However, when the dairy product category is divided into low-fat milk and whole milk and cheese, there is an obvious split in the data indicating that individuals generally consume foods in one group or the other. It is clear that low-fat dairy products can fit easily into a diet low in percentage of kilocalories from fat. Eggs and fish/chicken are both considered medium- to low-fat sources of animal protein, depending on cut and preparation factors. However, in our data, eggs were positively correlated with high-fat diets, while fish/chicken (fried varieties included) were not. These data suggest that eggs are associated with other high-fat eating practices, while fish/chicken consumption characterizes individuals who are not consuming a high-fat diet.

Our analysis focused on the relationship of dietary patterns with fat adjusted for calories, not with absolute fat intake. Because several different techniques are now in use to adjust fat for calories,[22] we used three methods to estimate correlation coefficients with nutrients and food groups. All three methods provided similar results.

Few studies have evaluated data regarding nutrient and food group intake on large representative samples as it relates to percentage of kilocalories from fat. Two small studies, however,

TABLE 5—Median Number of Servings per Week of Foods, by Percentage of Kilocalories from Fat Quartiles: National Health Interview Survey, 1987

Food	Quartile %[a] 1	2	3	4	Ratio[b]
Salty snacks	0.2	0.9	1.0	1.0	5.00
Peanuts	0.2	0.5	0.5	0.7	3.50
Processed meats	1.4	2.5	3.5	4.5	3.21
Whole milk and cheese	2.0	3.0	4.0	5.0	2.50
Desserts	2.0	3.2	4.0	4.0	2.00
Eggs	1.0	1.0	2.0	2.0	2.00
Fried potatoes	0.5	1.0	1.0	1.0	2.00
Soft drinks	0.5	1.2	2.0	1.0	2.00
Table fats	7.0	8.0	9.0	12.0	1.71
Red meat	2.3	3.2	3.7	3.9	1.70
All meat	6.2	7.9	9.3	10.4	1.68
All breads	7.0	7.2	7.2	7.2	1.03
Dairy products	7.0	7.0	7.0	7.0	1.00
Starches	5.9	6.1	6.5	5.9	1.00
Nonfried potatoes	2.0	2.0	2.0	2.0	1.00
All vegetables	13.9	13.0	12.9	12.2	0.88
Soup and stew	0.7	0.7	0.7	0.6	0.86
Fish and chicken	2.0	1.9	1.9	1.6	0.80
Salads	6.0	5.1	5.0	4.5	0.75
Garden vegetables	6.2	5.5	5.0	4.5	0.73
Fruits and vegetables	19.8	16.5	14.7	12.5	0.63
High-fiber bread/cereal	4.0	3.0	2.5	2.0	0.50
Fruits and juice	9.2	7.7	6.7	4.4	0.48
Ready-to-eat cereal	3.2	3.0	2.2	1.3	0.41
Citrus fruits	6.7	4.0	3.0	2.0	0.30
Alcoholic beverages	1.7	0.9	0.5	0.2	0.12
Low-fat milk	1.0	0.5	0.0	0.0	0.00

[a]Quartile cutpoints were 33.9%, 38.8%, and 43.3%.
[b]Ratio of quartile 4 to quartile 1.

have investigated changes in total diet as a result of dietary interventions designed to reduce fat intake.[7,8] These intervention studies measured somewhat different effects, since the participants were volunteers motivated by being at high risk for breast cancer and were given detailed instruction in decreasing fat to 15% to 20% of kilocalories while maintaining an adequate overall diet. Furthermore, individuals in our lowest quartile had a median intake of 30% of kilocalories from fat, a value much higher than the mean of approximately 22% achieved in the studies just mentioned.[7,8] Although 4-day food records were used to measure dietary intake in these studies, rather than the food frequency questionnaire approach used here, we nevertheless found similar dietary patterns associated with a low percentage of kilocalories from fat. Absolute mean intake of carbohydrate and protein in the low-fat diets declined very little (10% or less) in both of these studies, while total kilocalorie intake declined by about 25%. Our results show, on the basis of median intake, that individuals with low-fat (30% kilocalories from fat) compared with high-fat diets (46% kilocalories from fat) consume moderately less protein (17%) and energy (14%) but more carbohydrate (22%). In these studies, as in ours, absolute intakes of vitamins A and C[7,8] and folate[8] were higher in the low-fat diets, while calcium, thiamin, riboflavin, and niacin were not greatly affected. With respect to food groups, our data show dietary patterns similar to these studies; subjects with lower relative to higher fat diets reported consistently higher intakes of fruits[7,8] and vegetables,[8] and lower intakes of red and/or processed meat,[7,8] table fats,[7,8] desserts,[7,8] and salty snacks.[8]

Ursin et al.[23] conducted similar analyses of 10 306 adults using a more extensive 93-item food frequency questionnaire administered at the 1982 through 1984 follow-up of the NHANES I cohort. Although this questionnaire and the one used in the present study are different in length, the results for simple correlations between percentage of kilocalories from fat and either nutrient or food group intake are striking in their similarity. Results between the two studies regarding median intake of nutrients and food groups by percentage of kilocalories from fat quartile show that, in general, more marked differences appear in our data moving across quartiles. However, the direction and relative strength of the change for all food groups and nearly all nutrients are the same in both studies. The overall similarities in the results from these two large, nationally based studies provide convincing evidence that certain dietary patterns are consistently associated with a low percentage of kilocalories from fat in the American diet.

One of our initial purposes in conducting this research was to determine differences in correlations and dietary patterns associated with percentage of kilocalories from fat by demographic factors such as age, sex, race, education, and income. Surprisingly, we found few differences. While absolute intake of nutrients and foods did vary by demographics, relative intake, as expressed by our ratios in Tables 3 and 5, varied little by age and sex. Although nutritionists can conceive of many food group intake patterns low or high in percentage of kilocalories from fat, perhaps few distinct patterns actually exist. A possible reason for the few subgroup differences found here is that our short list of food items did not allow variability in dietary patterns to emerge.

In our data, percentage of kilocalories from fat was substantially lower in Hispanics. Our questionnaire, however, has not been compared with dietary records or recalls in this subgroup. In fact, many foods typical for Hispanic subgroups are not included on the questionnaire because such foods do not greatly contribute to total nutrient intake in the US population. In addition, reported intake of nearly all 59 food items was higher among Hispanics than among Blacks and Whites (L. C. Harlan, written communication, January 1993). These considerations, along with the smaller overall numbers of Hispanics, make the data for this important subgroup less trustworthy than those for other racial/ethnic groups, and further research is needed.

Our data show that Americans, on average, continue to consume a diet considered to be too high in fat (mean of 38.8% of kilocalories). Only in the lowest quartile did median values for percentage of kilocalories from fat approach the recommended level of 30% or less. However, individuals in the lowest relative to the highest quartile appeared to have dietary patterns most consistent with dietary guidelines both from a nutrient and food group perspective. This general finding is consistent with reported intakes of Americans adhering to a low-cholesterol diet in the NHANES II data[24] and among free-living families in Finland.[25] Nutrients of concern (e.g., iron and calcium) frequently found in higher fat foods appeared to be consumed in similar quantities by individuals in each quartile. Although it can be argued that many individuals should be consuming more of these nutrients, the present data suggest that lowering the percentage of kilocalories from fat may not necessarily decrease absolute intake of these important nutrients. As expected, absolute intakes of fatty acids and cholesterol were all lower in the lowest quartile, a generally positive outcome from a public health viewpoint. Vitamin E, however, was also lower, and this nutrient may play a role in both cancer and cardiovascular disease prevention.[26,27] Zinc and magnesium are reported to decline with decreasing fat intake[8]; however, because these minerals were not included on our database, we could not evaluate this possibility. This area of concern should be explored further as low-fat diets are recommended to the population.

It is clear from our data that individuals with a low percentage of kilocalories from fat tend to have dietary patterns notably higher in vitamin C and moderately higher in folate, dietary fiber, and carotene. All of these dietary constituents are being investigated for their role in reducing cancer risk. Our data show that when intakes of fat or nutrients/food groups are investigated, important concurrent dietary factors come into play and must be evaluated. Percentage of kilocalories from fat is highly correlated with certain nutrients and food groups but only weakly associated with others. One cannot be sure, therefore, whether an effect found for lower percentage intakes of kilocalories from fat is really due to higher intakes of vitamin C or folate unless each of these factors is independently evaluated. Assessing total diet is an important factor in sorting out diet and disease relationships.

Another important public health issue involves considering alcoholic beverage intake in studies assessing fat and chronic disease associations. Many heavy drinkers have low intakes of both total fat and percentage of kilocalories from fat and are thus placed in the "healthiest" dietary group, possibly obscuring important findings regarding diet and chronic disease risk. Recommendations for alcohol intake suggest moderation[1-6]; however, from a public health viewpoint, recommending a level of 30% of kilocalories or less for fat still leaves questions regarding how to account for alcohol kilocalories in reducing percentage of kilocalories from fat.

Individuals generally choose to eat foods and not nutrients, and food is selected in the context of a total diet and life-style. We have shown that a single important public health concern, percentage of kilocalories from fat, consistently correlates with selected food groups and nutrients. Individuals with diets low vs high in percentage of kilocalories from fat generally appear to most closely meet current dietary guidelines[6] (an exception is heavy alcohol consumers). The extensive and expensive dietary counseling among motivated women in diet trials[7,8] achieved diets generally lower in percentage of kilocalories from fat than are found in the US population. This approach, however, is not realistic from a public health perspective. Dietary guidelines should advocate a simple food message of increasing intake of fruits, vegetables, whole grains, and low-fat dairy products in a low-fat context. This positive message may not only increase the intake of nutrients/foods that might protect against chronic disease but may also reduce energy intake from fat. □

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Nominations Solicited for Environmental Health Award

The American Academy of Sanitarians is requesting nominations for the 12th annual Davis Calvin Wagner Award. The award, to be presented at the Academy Luncheon during the annual Educational Conference of the National Environmental Health Association, will consist of a plaque and a $500 honorarium. The award is open to all Diplomates of the Academy. Qualifications include the following:

1. The award recipient exhibits resourcefulness and dedication in promoting the improvement of the public's health through application of environmental health and public health practices.
2. The award recipient demonstrates professional, administrative, and technical skill and competence in raising the level of environmental health.
3. The recipient continues to improve him- or herself through involvement in continuing education programs to keep abreast of new developments in environmental health and public health.
4. The recipient is of such excellence as to merit Academy recognition.

Nomination for the award may be made by a colleague or a supervisor and must include the following: name, title, grade, and current place of employment; a description of the nominee's educational background and professional experience; a narrative statement of how the person meets the criteria for the award, including a description of specific accomplishments and contributions on which the nomination is based; and three endorsements (an immediate supervisor and two other members of the professional staff or other persons as appropriate).

The deadline for receipt of nominations is *April 15, 1994.* Three copies of the nomination must be submitted and should be sent to Dr John G. Todd, Chairman, Davis Calvin Wagner Award, 17309 Fletchall St, Poolesville, MD 20837.